THOMPSON CREEK MINING COMPANY (PWS 7190017 & 7190056) SOURCE WATER ASSESSMENT FINAL REPORT

April 25, 2003

State of Idaho
Department of Environmental Quality

Executive Summary

Under the Safe Drinking Water Act Amendments of 1996, all states are required by the U.S. Environmental Protection Agency (EPA) to assess every source of public drinking water for its relative sensitivity to contaminants regulated by the Act. This assessment is based on a land use inventory of the designated source water assessment area and sensitivity factors associated with the well and aquifer characteristics.

This report, *Source Water Assessment for the Thompson Creek Mining Company, Clayton, Idaho,* describes the public drinking water systems (PWSs), the boundaries of the zones of water contribution, and the associated potential contaminant sources located within these boundaries. This assessment should be used as a planning tool, taken into account with local knowledge and concerns, to develop and implement appropriate protection measures for this source. **The results should <u>not be</u> used as an absolute measure of risk and they should <u>not be</u> used to undermine public confidence in the water system.**

The Thompson Creek Mining Company drinking water system (PWS # 7190017 and PWS # 7190056) is a non-transient, non-community system that consists of two wells. The Concentrator Well (CON1 Well) has high susceptibility to volatile organic chemical (VOC) contaminants and synthetic organic chemical (SOC) contaminants, and a moderate susceptibility to inorganic chemical (IOC) contaminants and microbial contaminants. The Crusher Well (CRU1 Well) has high susceptibility to microbial contaminants, and moderate susceptibility to IOCs, VOCs, and SOCs.

The service road for the well and a lay-down yard runs within 40 feet of the CON 1 Well, resulting in high susceptibility to VOCs and SOCs due to the potential for fuel spills. Additionally, the VOC 1,1,1-trichloroethane was detected in the CON1 well in November 1996 and in November 2001, resulting in automatic high susceptibility to VOCs for the CON1 well. In December 1997, nitrate was detected in the CON1 Well at a level above the maximum contaminant level (MCL) of 10 milligrams per liter (mg/L). However, this detection is associated with setting off a charge in the casing to try and unplug the slots. All other nitrate detections have been at background levels (less than 2 mg/L). A repeated detection of total coliform bacteria in the CRU1 Well resulted in an automatically high susceptibility to microbial contamination for that well.

Total coliform bacteria were detected in the distribution system in June 1997, July 1997 and again in June 1998. A repeat detection of total coliform bacteria was detected at the CRU1 Well in June and July of 1997. No coliform bacteria have been detected in the CON1 Well. The IOCs fluoride and sodium were detected in both wells and sulfate, zinc, magnesium, copper, iron, lead, potassium, calcium, chloride, and silica have been detected in the CRU1 Well but at levels far below the MCLs set by the EPA. No SOCs have been recorded in either of the wells during any water chemistry tests.

The IOCs nitrate, thallium, and mercury were all detected in the system at levels greater than one-half their respective MCLs. However, the one high value for nitrate (10.7 mg/L in CON1) is explained by the unauthorized use of a charge being set off within the casing, and is therefore not the result of high nitrate in the source water. In 1993, arsenic was detected in the CRU1 Well at 6 micrograms per liter (μg/L), a level greater than one-half the recently revised MCL of 10 μg/L. In October 2001, the EPA reduced the arsenic MCL from 50 μg/L to 10 μg/L, giving public water systems until 2006 to comply with the new standard. Thallium (March 1994) and mercury (January 1991) were detected in the CON1 Well at levels greater than one-half their MCLs, however, neither of these IOCs have been detected since then. EPA requires reporting to the Consumer Confidence Report (CCR) if concentrations of detected compounds are greater than half their MCL. Further information and health side effects can be researched at http://www.epa.gov/safewater/ccr1.html.

The VOC 1,1,1-trichloroethane (TCA) was detected in the CON1 well in November 1996 at 0.017 mg/L and in November 2001 at 0.0072 mg/L. TCA is a colorless liquid, which is used as a solvent for cleaning metal parts. Drinking high levels of TCA may cause nervous system effects, liver damage, nausea, dizziness, slurred speech, and possibly death at very high concentrations. According to the operator, TCA has never been used on site.

This assessment should be used as a basis for determining appropriate new protection measures or re-evaluating existing protection efforts. No matter what ranking a source receives, protection is always important. Whether the source is currently located in a “pristine” area or an area with numerous industrial and/or agricultural land uses that require surveillance, the way to ensure good water quality in the future is to act now to protect valuable water supply resources.

For the Thompson Creek Mining Company’s drinking water wells, water protection activities should focus on correcting any deficiencies outlined in the sanitary surveys (inspections conducted every five years with the purpose of determining the physical condition of a water system’s components and its capacity), including upgrading the construction of the wells to further protect the drinking water (e.g. installing a vent on each well). Also, if microbial contamination becomes a problem, disinfection practices should be implemented. The Thompson Creek Mining Company may need to investigate various engineering solutions to eliminate any trichloroethane levels in the CON1 Well and to be aware of the lower arsenic MCL. The EPA plans to provide up to $20 million over the next two years for research and development of more cost-effective technologies to help small systems meet the new arsenic standard. Additionally, the EPA (2002) recently released issue papers entitled *Proven Alternatives for Aboveground Treatment of Arsenic in Groundwater* and *Arsenic Treatment Technologies for Soil, Waste, and Water* to assist public water systems in meeting the new requirement.

No chemicals are currently stored or applied within the 50-foot radius of the wellheads. This practice should continue. The Thompson Creek Mining Company may need to consider either diverting or limiting the access to the road that runs within 40 feet of the CON1 Well to avoid contamination associated with this corridor. Additionally, there should be a focus on the implementation of practices aimed at reducing the leaching of chemicals from mining practices and machine maintenance within the designated source water areas and awareness of the potential contaminant sources within the delineation zones. Since much of the designated protection areas are outside the direct jurisdiction of the Thompson Creek Mining Company, collaboration and partnerships with state and local agencies, and industry groups should be established and are critical to the success of drinking water protection.

Due to the time involved with the movement of ground water, drinking water protection activities should be aimed at long-term management strategies even though these strategies may not yield results in the near term. A strong public education program should be a primary focus of any drinking water protection plan as the delineation areas are near residential land uses. There are multiple resources available to help communities implement protection programs, including the Drinking Water Academy of the EPA.

A community must incorporate a variety of strategies in order to develop a comprehensive drinking water protection plan, be they regulatory in nature (e.g. zoning, permitting) or non-regulatory in nature (e.g. good housekeeping, public education, specific best management practices). For assistance in developing protection strategies please contact the Idaho Falls Regional Office of the Idaho Department of Environmental Quality or the Idaho Rural Water Association.

SOURCE WATER ASSESSMENT FOR THE THOMPSON CREEK MINING COMPANY, CLAYTON, IDAHO

Section 1. Introduction - Basis for Assessment

The following sections contain information necessary to understand how and why this assessment was conducted. **It is important to review this information to understand what the rankings of this assessment mean.** Maps showing the delineated source water assessment area and the inventory of significant potential sources of contamination identified within that area are attached. The list of significant potential contaminant source categories and their rankings used to develop the assessment is also included.

Background

Under the Safe Drinking Water Act Amendments of 1996, all states are required by the EPA to assess every source of public drinking water for its relative susceptibility to contaminants regulated by the Safe Drinking Water Act. This assessment is based on a land use inventory of the delineated assessment area and sensitivity factors associated with the wells and aquifer characteristics.

Level of Accuracy and Purpose of the Assessment

Since there are over 2,900 public water sources in Idaho, there is limited time and resources to accomplish the assessments. All assessments must be completed by May of 2003. An in-depth, site-specific investigation of each significant potential source of contamination is not possible. **Therefore, this assessment should be used as a planning tool, taken into account with local knowledge and concerns, to develop and implement appropriate protection measures for this source. The results should <u>not be</u> used as an absolute measure of risk and they should <u>not be</u> used to undermine public confidence in the water system.**

The ultimate goal of the assessment is to provide data to local communities to develop a protection strategy for their drinking water supply system. The Idaho Department of Environmental Quality (DEQ) recognizes that pollution prevention activities generally require less time and money to implement than treatment of a public water supply system once it has been contaminated. DEQ encourages communities to balance resource protection with economic growth and development. The decision as to the amount and types of information necessary to develop a drinking water protection program should be determined by the local community based on its own needs and limitations. Wellhead or drinking water protection is one facet of a comprehensive growth plan, and it can complement ongoing local planning efforts.

Section 2. Conducting the Assessment

General Description of the Source Water Quality

The public drinking water system for the Thompson Creek Mining Company is comprised of two ground water wells that serve approximately 35 people through 4 connections. Situated in Custer County, the wells are located up two separate drainages off of Thompson Creek. The CRU1 Well is located up Pat Hughes Creek drainage approximately one mile west of the CON1 Well (Figure 1).

The current significant potential water problems affecting the water system of the Thompson Creek Mining Company pertain to the detection of TCA at the CON1 Well and the repeated detection of total coliform bacteria in the CRU1 Well.

Total coliform bacteria were detected in the distribution system in June 1997, July 1997 and again in June 1998. A repeat detection of total coliform bacteria was detected at the CRU1 Well in June and July of 1997. No coliform bacteria have been detected in the CON1 Well. The IOCs fluoride and sodium were detected in both wells and sulfate, zinc, magnesium, copper, iron, lead, potassium, calcium, chloride, and silica have been detected in the CRU1 Well but at levels far below the MCLs set by the EPA. No SOCs have been recorded in any of the wells during any water chemistry tests.

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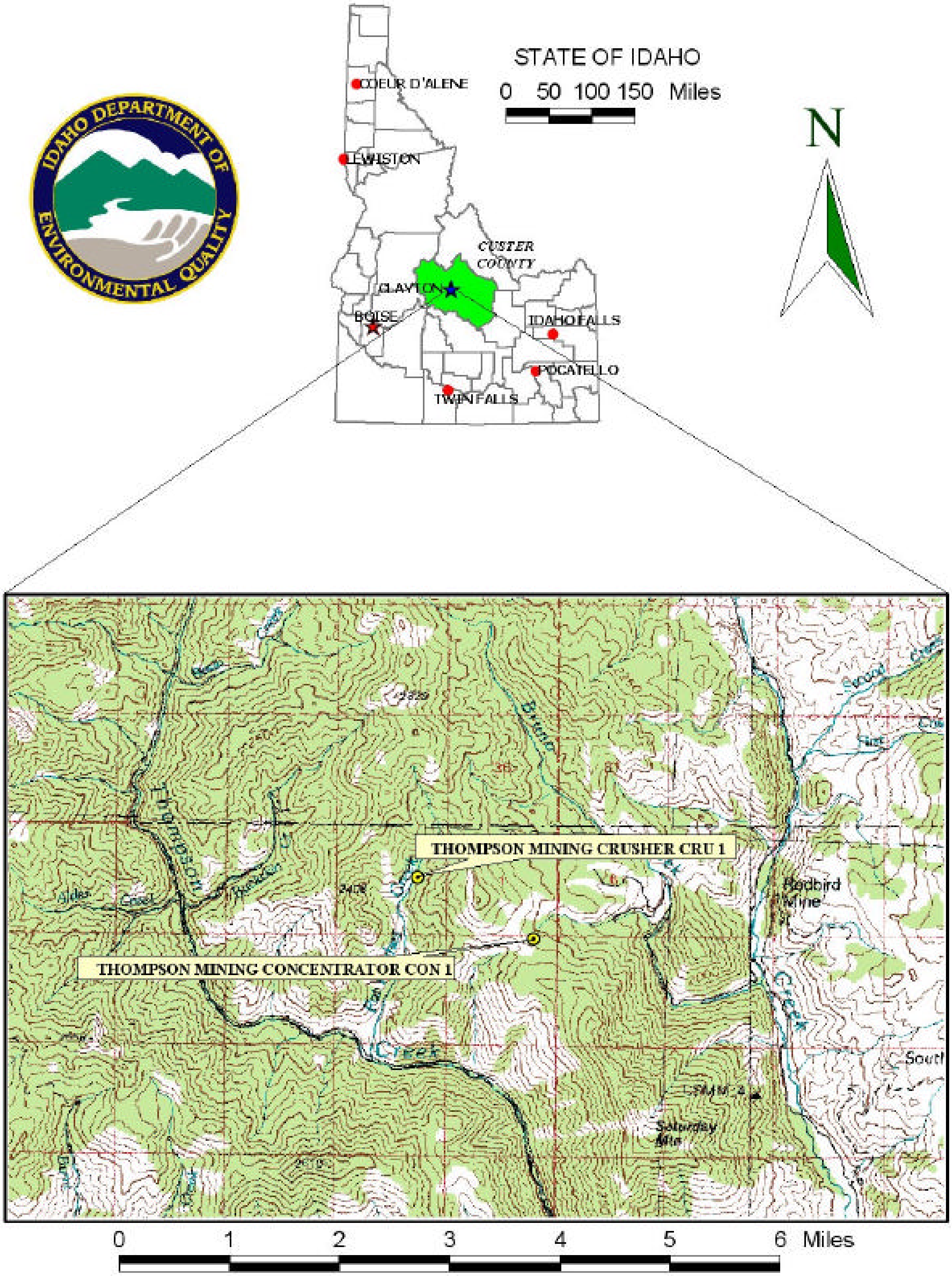
FIGURE 1 - Geographic Location of Thompson Mining Crusher & Concentrator Wells, PWS 7190017 & 7190056



Defining the Zones of Contribution – Delineation

The delineation process establishes the physical area around a well that will become the focal point of the assessment. The process includes mapping the boundaries of the zone of contribution into time-of-travel (TOT) zones (zones indicating the number of years necessary for a particle of water to reach a well) for water in the aquifer. DEQ contracted with Washington Group, International (WGI) to perform the delineations using a calculated fixed radius model approved by the EPA in determining the 3-year (Zone 1B), 6-year (Zone 2), and 10-year (Zone 3) TOT for water associated with the None hydrologic province aquifer in the vicinity of the wells of the Thompson Creek Mining Company. The computer model used site specific data, assimilated by WGI from a variety of sources including the Thompson Creek Mining Company operator input, local area well logs, and hydrogeologic reports (detailed below).

Hydrogeologic Conceptual Model

Graham and Campbell (1981) identified and described 70 regional ground water systems throughout Idaho. Thirty-four of these fall within the southeastern part of the state. The "None" hydrologic province, as defined in this report, includes all the area outside of the 34 regional systems in southeast Idaho. The smaller and more localized aquifers in the "None" province typically are situated in the foothills and mountains that surround and recharge the regional ground water systems.

The mountains and valleys within the "None" hydrologic province were formed during two events separated by approximately 50 to 70 million years (Alt and Hyndman, 1989, pp. 329 and 336). The overthrust belt of the northern Rocky Mountains was formed roughly 70 to 90 million years ago through the intrusion of granitic magma and a massive eastward movement of large slabs of layered sedimentary rocks along faults that dip shallowly westward (Alt and Hyndman, 1989, p. 329). This movement caused extreme folding and fracturing of the sedimentary and granitic rocks and, in many cases, left older formations lying on top of younger ones. Later Basin and Range block faulting broke up the largely eroded Rocky Mountains into large uplifted and downthrown blocks resulting in the present day northwest trending mountains and valleys seen throughout southeast Idaho. Paleozoic and Precambrian limestone, dolomite, sandstone, shale, siltstone, and quartzite are the predominant materials forming the mountains and probably compose the bedrock underlying the valleys between Salmon, Idaho on the north side of the Snake River Plain and Franklin, Idaho near the Utah/Idaho border (Dion, 1969, p.18; Kariya et al., 1994, p. 6; Bjorklund and McGreevy, 1971, p. 12; and Parliman, 1982, p. 9).

Ground water movement in the mountains is primarily through a system of solution channels, fractures and joints that commonly transmit water independently of surface topography (Bjorklund and McGreevy, 1971, p. 15; Dion, 1969, p. 18). Ralston and others (1979, pp. 128-129) state that the geologic structural features also can contribute to the development of cross-basin ground water flow systems. Ground water entering a geologic formation tends to follow the formation because hydraulic conductivities are greater parallel to the bedding planes than across them. Synclines and anticlines provide structural avenues for ground water flow under ridges from one valley to another.

The average annual precipitation in the mountains of southeast Idaho ranges from 20 inches on ridges near Soda Springs to over 45 inches on the Bear River Range (Ralston and Trihey, 1975, p. 7, and Dion, 1969, p. 11). The valleys receive an average of 7 to 10 inches annually (Donato, 1998, p. 3, and Dion, 1969, p. 11). Precipitation and seepage from streams are the primary source of recharge to the mountain aquifers (Kariya, et al., 1994, p. 18, and Parliman, 1982, p. 13).

Ground water discharge occurs as springs and seeps issuing from faults, fractures, and solution channels and as underflow to regional aquifers. The Bear River Basin in the far southeast corner of the state contains hundreds of springs issuing primarily from fractures and solution openings in the bedrock mountains (Dion, 1969, p. 47, and Bjorklund and McGreevy, 1971, pp. 34-35). Within Cache Valley many springs discharge from the valley-fill deposits (Kariya et al., 1994, p. 32).

There is little available information on the distribution of hydraulic head and the hydraulic properties of the aquifers in the "None" hydrologic province. No U.S. Geological Survey (2001) or Idaho Statewide Monitoring Network (Neely, 2001) wells are located in the areas of concern to provide information on ground water flow direction and hydraulic gradient or to aid in model calibration. The information that is available indicates that the hydraulic properties are quite variable, even within a specific rock type. Ralston and others (1979, p. 31), for example, present hydraulic conductivity estimates for fractured chert ranging from 2.2 to 75 feet per day (ft/day). Estimates for phosphatic shale are as low as 0.07 ft/day (unfractured) and as high as 25 ft/day (fractured).

Calculated Fixed-Radius Method

The calculated fixed-radius method (IDEQ, 1997 p. 4-9) was used to delineate capture zones for PWS wells in the "None" hydrologic province. The fixed radii for the 3-, 6-, and 10-year capture zones were calculated using equations presented by Keely and Tsang (1983) for the velocity distribution surrounding a pumping well. This method was selected because the ground-water flow systems in the mountains of southeast Idaho are typically very complex and poorly characterized. Ground-water infiltrating into folded, faulted, and fractured bedrock formations may recharge shallow localized systems with short flow paths and residence times or it may enter deeper intermediate or regional systems with longer flow paths and residence times. Unfortunately, there generally are no water level data with which to determine the flow direction and hydraulic gradient in the different aquifers. In the absence of water level data, the groundwater flow direction and hydraulic gradient may differ greatly from one flow system to another, because of the existence of structural controls and heterogeneity.

The PWS #7190056 well is completed in a basalt and rhyolite aquifer. The capture zone radii were calculated using a hydraulic conductivity of 0.72 ft/day. The hydraulic conductivity is derived from transmissivity estimates and aquifer thickness data presented in Nalven (1983, p. 2) for the Crusher – CRU 1 well (PWS #7190056). The effective porosity and hydraulic gradients are the default values presented in Table F-3 of the Idaho Wellhead Protection Plan for mixed volcanic and sedimentary rocks, primarily volcanic rocks (IDEQ, 1997, p. F-6). The aquifer thickness used for calculations is the aquifer thickness presented in Nalven (1983, p. 2). Because no pumping rate data are available, the assumed pumping rate for the well is 1.5 times the demand of 40 gal/min for which the well was originally designed (Nalven, 1983, cover letter).

The PWS #7190017 well is completed in a limestone aquifer. The capture zone radii were calculated using a hydraulic conductivity of 0.78 ft/day which is based on a published transmissivity of 100 ft2/day (748 gal/day/ft) and an aquifer thickness of 128 feet. The transmissivity was estimated from data collected during a step test conducted shortly after the well's construction (Bugenig, 1981, p. 9). The aquifer thickness is the total perforated interval of the well casing. The effective porosity and hydraulic gradient are the default values for mixed volcanic and sedimentary rocks, primarily sedimentary rocks (IDEQ, 1997, p. F-6). Because no pumping rate data are available, the assumed rate is the estimated sustainable yield (100 gal/min; Bugenig, 1981, p. 13).

The delineated source water assessment areas for the wells of the Thompson Creek Mining Company can best be described as three concentric circles extending radially for 964 feet for the CON1 Well and 766 feet for the CRU1 Well (Figures 2 and 3). The actual data used by WGI in determining the source water assessment delineation areas are available from DEQ upon request.

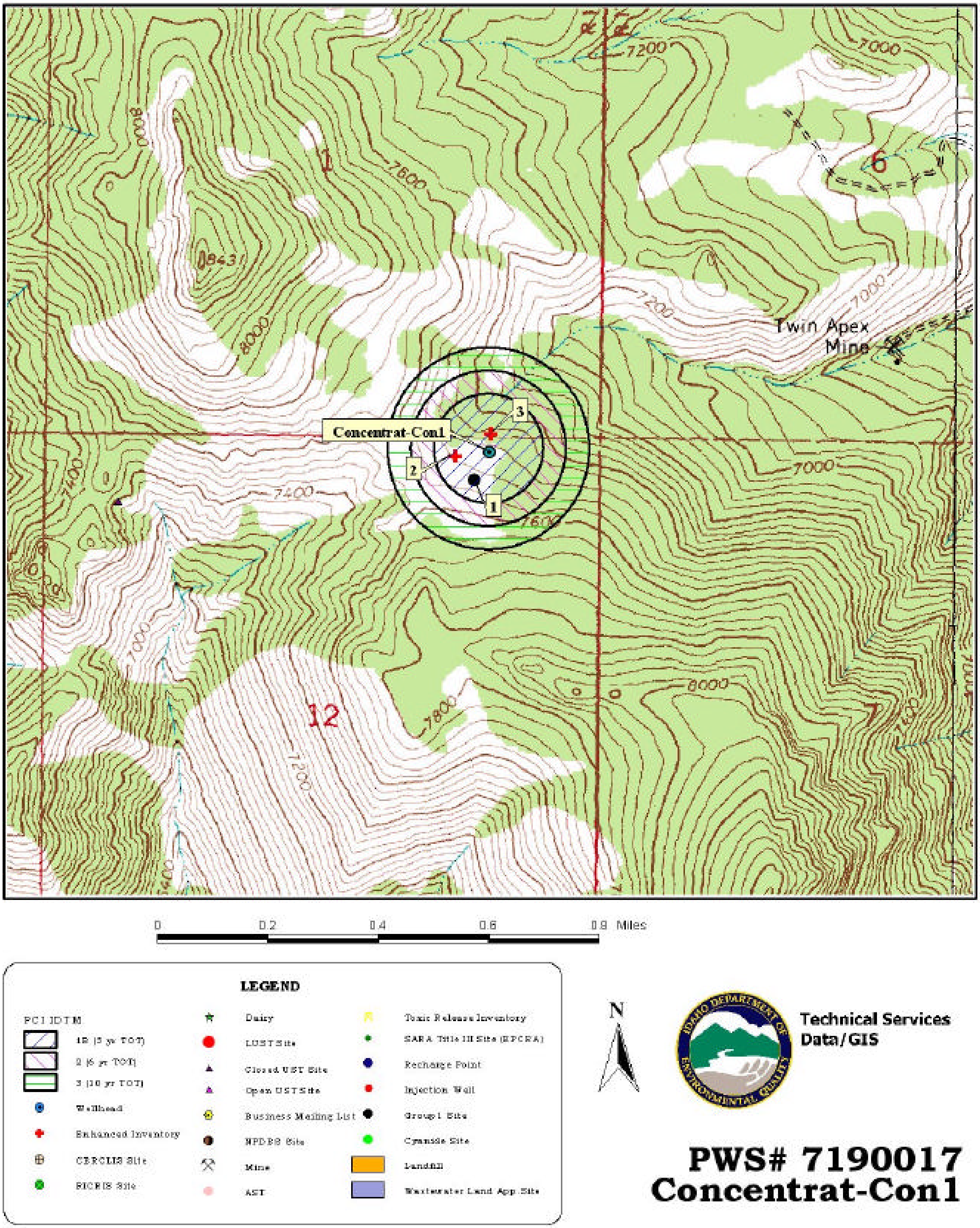
Identifying Potential Sources of Contamination

A potential source of contamination is defined as any facility or activity that stores, uses, or produces, as a product or by-product, the contaminants regulated under the Safe Drinking Water Act and others, such as cryptosporidium, and has a sufficient likelihood of releasing such contaminants at levels that could pose a concern relative to drinking water sources. The goal of the inventory process is to locate and describe those facilities, land uses, and environmental conditions that are potential sources of groundwater contamination. The locations of potential sources of contamination within the delineation areas were obtained by field surveys conducted by DEQ and from available databases.

Land use within the immediate and surrounding area of wells of the Thompson Creek Mining Company consists of mostly woodland and rangeland use.

It is important to understand that a release may never occur from a potential source of contamination provided they are using best management practices. Many potential sources of contamination are regulated at the federal level, state level, or both to reduce the risk of release. Therefore, when a business, facility, or property is identified as a potential contaminant source, this should not be interpreted to mean that this business, facility, or property is in violation of any local, state, or federal environmental law or regulation. What it does mean is that the potential for contamination exists due to the nature of the business, industry, or operation. There are a number of methods that water systems can use to work cooperatively with potential sources of contamination, including educational visits and inspections of stored materials. Many owners of such facilities may not even be aware that they are located near a public water supply well.

FIGURE 2 - Thompson Mining Conentrator Delineation Map and Potential Contaminant Source Locations



Technical Services
Data/GIS

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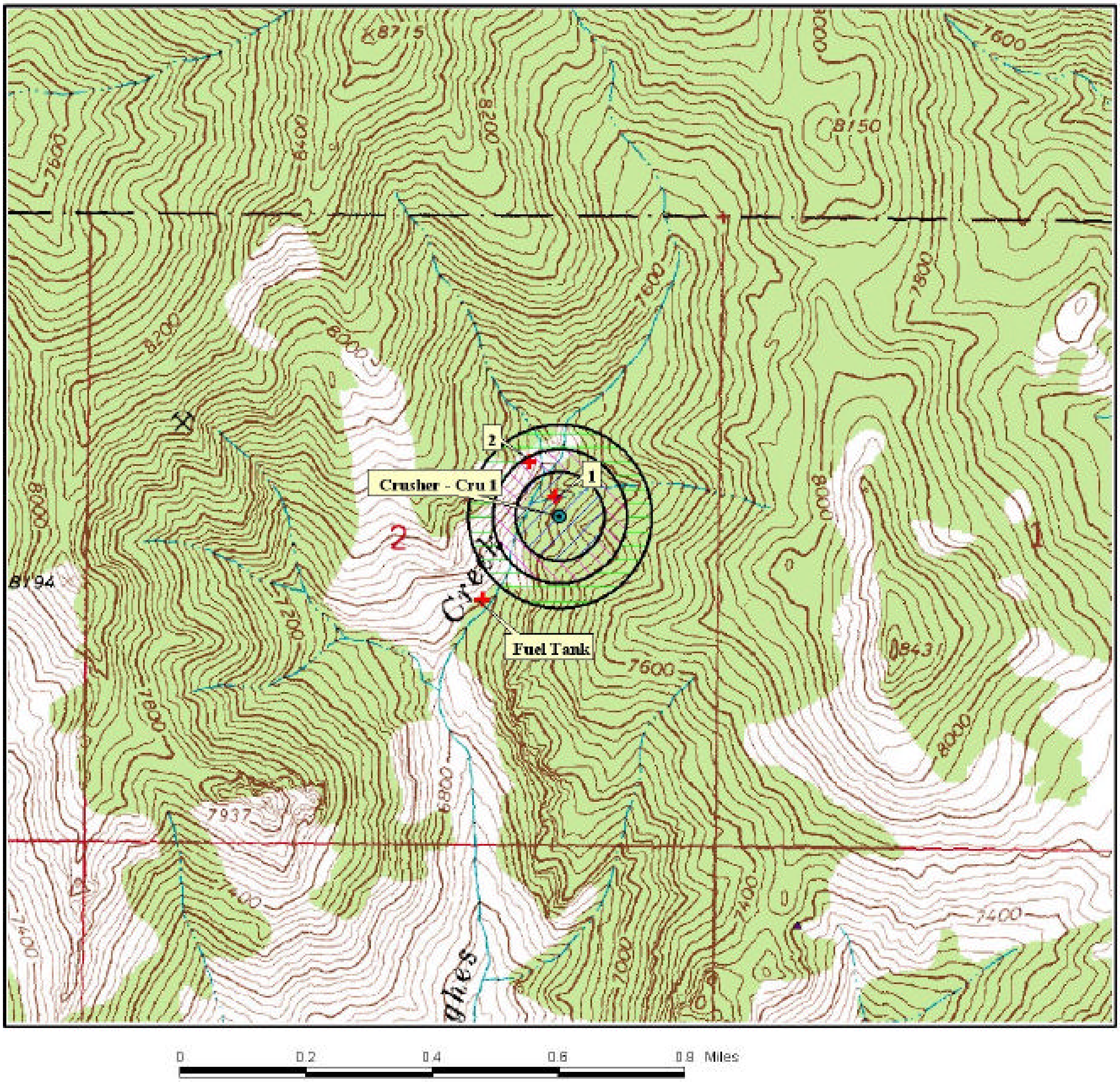
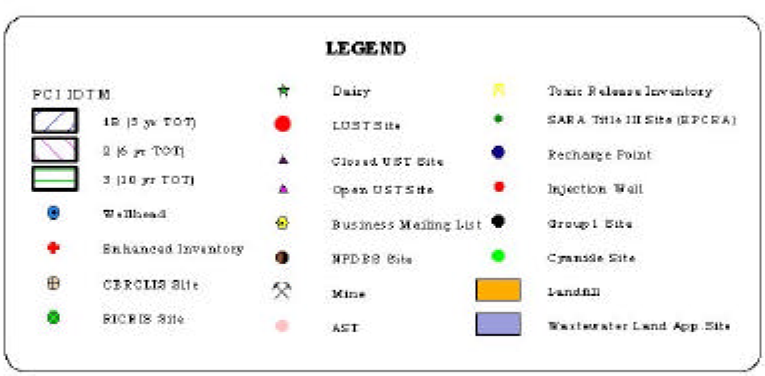
Concentrat-Con1

FIGURE 3 - Thompson Mining Crusher Delineation Map and Potential Contaminant Source Locations





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Crusher - Cru 1

Contaminant Source Inventory Process

A two-phased contaminant inventory of the study area was conducted in September and October 2002. The first phase involved identifying and documenting potential contaminant sources within the Thompson Creek Mining Company Source Water Assessment Areas (Figures 2 and 3) through the use of field surveys, computer databases, and Geographic Information System (GIS) maps developed by DEQ. The second, or enhanced, phase of the contaminant inventory involved contacting the operator to identify and add any additional potential sources in the areas.

The delineated source water areas encompass circular shaped areas of land extending radially from the well sites and ending approximately one-eighth of a mile away in all directions. The delineation for the CON1 Well includes the well service road that runs within 40 feet of the wellhead (identified by the 1999 sanitary survey), a fuel tank with secondary containment, a warehouse of lubes and greases, and a site that tested for greater than 10 mg/L of nitrate (Figure 2, Table 1). The delineation for the CRU1 well includes a maintenance shop, a lube facility, and Pat Hughes Creek (Figure 3, Table 2).

Table 1. CON1 Well of the Thompson Creek Mining Company, Potential Contaminant Inventory

Site #	Source Description[1]	TOT ZONE[2]	Source of Information	Potential Contaminants[3]
1	Group 1 = Nitrate >10 mg/L	0 – 3	Database Search	IOC
2	Fuel Tank	0 – 3	Enhanced Inventory	VOC, SOC
3	Warehouse (lubes and greases)	0 – 3	Enhanced Inventory	IOC, VOC, SOC
	Mining Pit Road	0 – 3 (1A)	Sanitary Survey	IOC, VOC, SOC, Microbials

[2] TOT = time-of-travel (in years) for a potential contaminant to reach the wellhead
[3] IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical

Table 2. CRU1 Well of the Thompson Creek Mining Company, Potential Contaminant Inventory

Site #	Source Description[1]	TOT ZONE[2]	Source of Information	Potential Contaminants[3]
1	Maintenance Shop	0 – 3	Enhanced Inventory	IOC, VOC, SOC
2	Lube Facility	3 – 6	Enhanced Inventory	IOC, VOC, SOC
	Pat Hughes Creek	1 – 10	GIS Map	IOC, VOC, SOC, Microbials

[2] TOT = time-of-travel (in years) for a potential contaminant to reach the wellhead
[3] IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical

Section 3. Susceptibility Analyses

Each well's susceptibility to contamination was ranked as high, moderate, or low risk according to the following considerations: hydrologic characteristics, physical integrity of the well, land use characteristics, and potentially significant contaminant sources (Table 3). Each of these three categories carries the same weight in the final assessment, meaning that a low score in one category coupled with higher scores in the other categories can still lead to a overall susceptibility of high. The susceptibility rankings are specific to a particular potential contaminant or category of contaminants. Therefore, a high susceptibility rating relative to one potential contaminant does not mean that the water system is at the same risk for all other potential contaminants. The relative ranking that is derived for each well is a qualitative, screening-level step that, in many cases, uses generalized assumptions and best professional judgement. Appendix A contains the susceptibility analysis worksheet for the system. The following summaries describe the rationale for the susceptibility ranking.

Hydrologic Sensitivity

The hydrologic sensitivity of a well is dependent upon four factors: the surface soil composition, the material in the vadose zone (between the land surface and the water table), the depth to first ground water, and the presence of a 50-foot thick fine-grained zone above the producing zone of the well. Slowly draining soils such as silt and clay typically are more protective of ground water than coarse-grained soils such as sand and gravel. Similarly, fine-grained sediments in the subsurface and a water depth of more than 300 feet protect the ground water from contamination.

Hydrologic sensitivity rates moderate for both of the Thompson Creek Mining Company wells (Table 3). The soils surrounding the area of the wellheads are in the poor to moderate-draining soil class, reducing the downward movement of contaminants to the aquifer. However, the well log for the CON1 Well indicates that the vadose zone is composed mostly of volcanic rock and first ground water is located at 140 feet below ground surface (bgs). The well log for the CRU1 Well was not available, preventing a determination of the composition of the vadose zone, the presence of low permeability layers, and the location of first ground water.

Well Construction

Well construction directly affects the ability of the well to protect the aquifer from contaminants. System construction scores are reduced when information shows that potential contaminants will have a more difficult time reaching the intake of the well. Lower scores imply a system is less vulnerable to contamination. For example, if the well casing and annular seal both extend into a low permeability unit, then the possibility of contamination is reduced and the system construction score goes down. If the highest production interval is more than 100 feet below the water table, then the system is considered to have better buffering capacity. If the wellhead and surface seal are maintained to standards, as outlined in Sanitary surveys, then contamination down the well bore is less likely. If the well is protected from surface flooding and is outside the 100-year floodplain, then contamination from surface events is reduced.

The CON1 Well was drilled in 1981 to a depth of 500 feet bgs. It has a 0.250-inch thick, 10-inch diameter casing set from 2.5 feet above ground surface (ags) to 152.7 feet bgs into black carbonaceous shale, a 0.250-inch thick, 8-inch diameter casing from 152.7 feet bgs to 396.25 feet bgs set into limestone, and a 0.250-inch thick, 6-inch diameter casing set from 396.25 feet bgs to 496.10 feet bgs into limestone. The well is sealed from 0 feet bgs to 40 feet bgs ending in a layer of volcanic cinder. The casing is perforated from 360.4 feet bgs to 396.25 feet bgs and again at 404 feet bgs to 496.85 feet bgs. The static water level is found at 124.7 feet bgs. The well currently produces 100 gallons per minute (gpm).

The well log for the CRU1 Well was not available. However, the Public Water System Questionnaire and the Testing Report for the CRU1 Well provided some useful information. The well was drilled in 1983 to a depth of 501 feet bgs. It has a 12-inch diameter casing set to 47 feet bgs followed by a 10-inch diameter casing set from one-foot ags to 200 feet bgs followed by an 8-inch diameter casing set from 200 feet bgs to 501 feet bgs. The well is sealed down to 47 feet bgs. The casing is perforated from 200 feet bgs to 460 feet bgs and the static water level is found at 89 feet bgs. The well produces approximately 150 gpm.

For the system construction of the Thompson Creek Mining Company wells, the CON1 Well rated moderate and the CRU1 Well rated high. According to the 1999 sanitary survey, the wellhead and surface seals are maintained to standards for both wells but neither well has a casing vent. The purpose of the vent is to vent the space between the casing and the column and prevent a vacuum from forming when the well turns on and draws down the water table. A vacuum could draw in contamination through joints or leaks in the casing or cause the well to slough. The sanitary survey also indicates that the CRU1 Well is properly protected from flooding. However, the casing of the CON1 Well only extends 12 inches above ground surface. According to the well construction standards, the casing must extend at least 12 inches above the floor and at least 18 inches above ground surface to properly protect the well from surface flooding. Both wells are located outside a 100-year flood plain and the highest production zones for both wells are found at a depth greater than 100 feet below the static water level.

Though the wells may have been in compliance with standards when they were completed, current public water system (PWS) well construction standards are more stringent. The Idaho Department of Water Resources *Well Construction Standards Rules* (1993) require all PWSs to follow DEQ standards as well. IDAPA 58.01.08.550 requires that PWSs follow the *Recommended Standards for Water Works* (1997) during construction. These standards include provisions for well screens, pumping tests, and casing thicknesses to name a few. Table 1 of the *Recommended Standards for Water Works* (1997) lists the required steel casing thickness for various diameter wells. A 12-inch diameter casing requires a thickness of 0.375 of an inch and a 10-inch diameter casing requires a thickness of 0.365 of an inch. An 8-inch diameter casing requires a thickness of 0.322 of an inch and a 6-inch diameter casing requires a thickness of 0.280 of an inch. Both wells did not meet well construction standards and therefore, were assessed an additional point in the system construction rating.

Potential Contaminant Source and Land Use

In the potential contaminant/land use section of the susceptibility scoring, the CON1 Well of the Thompson Creek Mining Company rated low for IOCs (e.g. nitrates arsenic), VOCs (e.g. petroleum products), SOCs (e.g. pesticides) and microbial contaminants (e.g. bacteria). The CRU1 Well rated moderate for IOCs, VOCs, and SOCs, and rated low for microbial contaminants. Pat Hughes Creek that stretches through the 3-year, 6-year, and 10-year TOT zones of the CRU1 Well delineation contributed to the potential contaminant source and land use score of the well. This waterway could add leachable contaminants to the aquifer in all three TOT zones in the case of an accidental spill or release. All of the potential contaminants within the CON1 Well delineation are included only in the 3-year TOT zone. The predominant woodland or rangeland land use of the area surrounding both wells reduced the land use scores.

Final Susceptibility Ranking

A detection above a drinking water standard MCL, any detection of a VOC or SOC at the well, or a detection of total coliform bacteria or fecal coliform bacteria at the wellhead will automatically give a high susceptibility rating to a well despite the land use of the area because a pathway for contamination already exists. The VOC 1,1,1-trichloroethane was detected at different times the CON1 Well, resulting in an automatic high susceptibility to VOCs. Also, in 1997, total coliform bacteria were detected at the CRU1 Well, resulting in an automatic high susceptibility to microbial contaminants for that well. Additionally, if there are contaminant sources located within 50 feet of the source then the wellhead will automatically get a high susceptibility rating. According to the 1999 sanitary survey, a well service road runs within 40 feet of the CON1 Well, resulting in high susceptibility to VOCs and SOCs. Hydrologic sensitivity and system construction scores are heavily weighted in the final scores. Having multiple potential contaminant sources in the 0- to 3-year time of travel zone (Zone 1B) and agricultural land contribute greatly to the overall ranking. In terms of total susceptibility, the CON1 Well rates moderate for IOCs and microbials and high for VOCs and SOCs. The CRU1 rates high for microbials and moderate for IOCs, VOCs, and SOCs.

Table 3. Summary of Thompson Creek Mining Company Susceptibility Evaluation

Well	Susceptibility Scores[1]									
	Hydrologic Sensitivity	Contaminant Inventory				System Construction	Final Susceptibility Ranking			
		IOC	VOC	SOC	Microbials		IOC	VOC	SOC	Microbials
CON1 Well	M	L	L	L	L	M	M	H*	H*	M
CRU1 Well	M	M	M	M	L	H	M	M	M	H*

[1]H = High Susceptibility, M = Moderate Susceptibility, L = Low Susceptibility,
IOC = inorganic chemical, VOC = volatile organic chemical, SOC = synthetic organic chemical
*** = Automatic high susceptibility score due to a road that runs within 40 feet of CON1 Well, a detection of the VOC 1,1,1-trichloroethylene (CON1 well), and the repeat detection of total coliform bacteria at the CRU1 Well**

Susceptibility Summary

Overall, the CON1 Well has moderate susceptibility to IOCs and microbial contaminants and high susceptibility to VOCs and SOCs. The CRU1 Well has high susceptibility to microbial contaminants, and moderate susceptibility to IOCs, VOCs, and SOCs.

The service road for the well and a lay-down yard runs within 40 feet of the CON 1 Well, resulting in high susceptibility to VOCs and SOCs due to the potential for fuel spills. Additionally, the VOC 1,1,1-trichloroethane was detected in the CON1 well in November 1996 and in November 2001, resulting in automatic high susceptibility to VOCs for the CON1 well. In December 1997, nitrate was detected in the CON1 Well at a level above the MCL of 10 mg/L. However, this detection is associated with setting off a charge in the casing to try and unplug the slots. All other nitrate detections have been at background levels (less than 2 mg/L). A repeated detection of total coliform bacteria in the CRU1 Well resulted in an automatically high susceptibility to microbial contamination for that well.

Total coliform bacteria were detected in the distribution system in June 1997, July 1997 and again in June 1998. A repeat detection of total coliform bacteria was detected at the CRU1 Well in June and July of 1997. No coliform bacteria have been detected in the CON1 Well. The IOCs fluoride and sodium were detected in both wells and sulfate, zinc, magnesium, copper, iron, lead, potassium, calcium, chloride, and silica have been detected in the CRU1 Well but at levels far below the MCLs set by the EPA. No SOCs have been recorded in either of the wells during any water chemistry tests.

The IOCs nitrate, thallium, and mercury were all detected in the system at levels greater than one-half their respective MCLs. However, the one high value for nitrate (10.7 mg/L in CON1) is explained by the unauthorized use of a charge being set off within the casing, and is therefore not the result of high nitrate in the source water. In 1993, arsenic was detected in the CRU1 Well at 6 micrograms per liter (µg/L), a level greater than one-half the recently revised MCL of 10 µg/L. In October 2001, the EPA reduced the arsenic MCL from 50 µg/L to 10 µg/L, giving public water systems until 2006 to comply with the new standard. Thallium (March 1994) and mercury (January 1991) were detected in the CON1 Well at levels greater than one-half their MCLs, however, neither of these IOCs have been detected since then. EPA requires reporting to the CCR if concentrations of detected compounds are greater than half their MCL. Further information and health side effects can be researched at http://www.epa.gov/safewater/ccr1.html.

The VOC 1,1,1-trichloroethane (TCA) was detected in the CON1 well in November 1996 at 0.017 mg/L and in November 2001 at 0.0072 mg/L. TCA is a colorless liquid, which is used as a solvent for cleaning metal parts. Drinking high levels of TCA may cause nervous system effects, liver damage, nausea, dizziness, slurred speech, and possibly death at very high concentrations. According to the operator, TCA has never been used on site.

Section 4. Options for Drinking Water Protection

The susceptibility assessment should be used as a basis for determining appropriate new protection measures or re-evaluating existing protection efforts. No matter what the susceptibility ranking a source receives, protection is always important. Whether the source is currently located in a “pristine” area or an area with numerous industrial and/or agricultural land uses that require surveillance, the way to ensure good water quality in the future is to act now to protect valuable water supply resources.

An effective drinking water protection program is tailored to the particular local drinking water protection area. A community with a fully developed source water protection program will incorporate many strategies. For the Thompson Creek Mining Company’s drinking water wells, water protection activities should focus on correcting any deficiencies outlined in the sanitary surveys, including upgrading the construction of the wells to further protect the drinking water (e.g. installing a vent on each well). Also, if microbial contamination becomes a problem, disinfection practices should be implemented. The Thompson Creek Mining Company may need to investigate various engineering solutions to eliminate any trichloroethane levels in the CON1 Well and to be aware of the lower arsenic MCL. The EPA plans to provide up to $20 million over the next two years for research and development of more cost-effective technologies to help small systems meet the new arsenic standard. Additionally, the EPA (2002) recently released issue papers entitled *Proven Alternatives for Aboveground Treatment of Arsenic in Groundwater* and *Arsenic Treatment Technologies for Soil, Waste, and Water* to assist public water systems in meeting the new requirement.

No chemicals are currently stored or applied within the 50-foot radius of the wellheads. This practice should continue. The Thompson Creek Mining Company may need to consider either diverting or limiting the access to the road that runs within 40 feet of the CON1 Well to avoid contamination associated with this corridor. Additionally, there should be a focus on the implementation of practices aimed at reducing the leaching of chemicals from mining practices and machine maintenance within the designated source water areas and awareness of the potential contaminant sources within the delineation zones. Since much of the designated protection areas are outside the direct jurisdiction of the Thompson Creek Mining Company, collaboration and partnerships with state and local agencies, and industry groups should be established and are critical to the success of drinking water protection.

Due to the time involved with the movement of ground water, drinking water protection activities should be aimed at long-term management strategies even though these strategies may not yield results in the near term. A strong public education program should be a primary focus of any source water protection plan as the delineations are near to urban and residential land uses. There are multiple resources available to help communities implement protection programs, including the Drinking Water Academy of the EPA. Drinking water protection activities for agriculture should be coordinated with the Idaho State Department of Agriculture, the Soil Conservation Commission, the local Soil Conservation District, and the Natural Resources Conservation Service.

A community must incorporate a variety of strategies in order to develop a comprehensive source water assessment protection plan, be they regulatory in nature (e.g. zoning, permitting) or non-regulatory in nature (e.g. good housekeeping, public education, specific best management practices). For assistance in developing protection strategies please contact the Idaho Falls Regional Office of the DEQ or the Idaho Rural Water Association.

Assistance

Public water supplies and others may call the following DEQ offices with questions about this assessment and to request assistance with developing and implementing a local protection plan. In addition, draft protection plans may be submitted to the DEQ office for preliminary review and comments.

Idaho Falls Regional DEQ Office (208) 528-2650

State DEQ Office (208) 373-0502

Website: http://www.deq.state.id.us

Water suppliers serving fewer than 10,000 persons may contact Melinda Harper (mlharper@idahoruralwater.com), Idaho Rural Water Association, at 1-208-343-7001 for assistance with drinking water protection (formerly wellhead protection) strategies.

POTENTIAL CONTAMINANT INVENTORY
LIST OF ACRONYMS AND DEFINITIONS

AST (Aboveground Storage Tanks) – Sites with aboveground storage tanks.

Business Mailing List – This list contains potential contaminant sites identified through a yellow pages database search of standard industry codes (SIC).

CERCLIS – This includes sites considered for listing under the **Comprehensive Environmental Response Compensation and Liability Act (CERCLA)**. CERCLA, more commonly known as Superfund is designed to clean up hazardous waste sites that are on the national priority list (NPL).

Cyanide Site – DEQ permitted and known historical sites/facilities using cyanide.

Dairy – Sites included in the primary contaminant source inventory represent those facilities regulated by Idaho State Department of Agriculture (ISDA) and may range from a few head to several thousand head of milking cows.

Deep Injection Well – Injection wells regulated under the Idaho Department of Water Resources generally for the disposal of stormwater runoff or agricultural field drainage.

Enhanced Inventory – Enhanced inventory locations are potential contaminant source sites added by the water system. These can include new sites not captured during the primary contaminant inventory, or corrected locations for sites not properly located during the primary contaminant inventory. Enhanced inventory sites can also include miscellaneous sites added by the Idaho Department of Environmental Quality (DEQ) during the primary contaminant inventory.

Floodplain – This is a coverage of the 100year floodplains.

Group 1 Sites – These are sites that show elevated levels of contaminants and are not within the priority one areas.

Inorganic Priority Area – Priority one areas where greater than 25% of the wells/springs show constituents higher than primary standards or other health standards.

Landfill – Areas of open and closed municipal and non-municipal landfills.

LUST (Leaking Underground Storage Tank) – Potential contaminant source sites associated with leaking underground storage tanks as regulated under RCRA.

Mines and Quarries – Mines and quarries permitted through the Idaho Department of Lands.)

Nitrate Priority Area – Area where greater than 25% of wells/springs show nitrate values above 5 mg/L.

NPDES (National Pollutant Discharge Elimination System) – Sites with NPDES permits. The Clean Water Act requires that any discharge of a pollutant to waters of the United States from a point source must be authorized by an NPDES permit.

Organic Priority Areas – These are any areas where greater than 25% of wells/springs show levels greater than 1% of the primary standard or other health standards.

Recharge Point – This includes active, proposed, and possible recharge sites on the Snake River Plain.

RICRIS – Site regulated under **Resource Conservation Recovery Act (RCRA)**. RCRA is commonly associated with the cradle to grave management approach for generation, storage, and disposal of hazardous wastes.

SARA Tier II (Superfund Amendments and Reauthorization Act Tier II Facilities) – These sites store certain types and amounts of hazardous materials and must be identified under the Community Right to Know Act.

Toxic Release Inventory (TRI) – The toxic release inventory list was developed as part of the Emergency Planning and Community Right to Know (Community Right to Know) Act passed in 1986. The Community Right to Know Act requires the reporting of any release of a chemical found on the TRI list.

UST (Underground Storage Tank) – Potential contaminant source sites associated with underground storage tanks regulated as regulated under RCRA.

Wastewater Land Applications Sites – These are areas where the land application of municipal or industrial wastewater is permitted by DEQ.

Wellheads – These are drinking water well locations regulated under the Safe Drinking Water Act. They are not treated as potential contaminant sources.

NOTE: Many of the potential contaminant sources were located using a geocoding program where mailing addresses are used to locate a facility. Field verification of potential contaminant sources is an important element of an enhanced inventory.

Where possible, a list of potential contaminant sites unable to be located with geocoding will be provided to water systems to determine if the potential contaminant sources are located within the source water assessment area.

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Appendix A

Thompson Creek Mining Company Susceptibility Analysis Worksheets

The final scores for the susceptibility analysis were determined using the following formulas:

1) VOC/SOC/IOC Final Score = Hydrologic Sensitivity + System Construction + (Potential Contaminant/Land Use x 0.2)

2) Microbial Final Score = Hydrologic Sensitivity + System Construction + (Potential Contaminant/Land Use x 0.375)

Final Susceptibility Scoring:

0 - 5 Low Susceptibility

6 - 12 Moderate Susceptibility

≥ 13 High Susceptibility

Ground Water Susceptibility Report   Public Water System Name :   THOMPSON CREEK MINING CONCENTRATOR CON 1   Well# : CONCENTRAT-CON1

Public Water System Number 7190017   1/3/03 3:13:14 PM

1. System Construction

		SCORE
Drill Date	5/20/81	
Driller Log Available	YES	
Sanitary Survey (if yes, indicate date of last survey)	YES	1999
Well meets IDWR construction standards	NO	1
Wellhead and surface seal maintained	NO	1
Casing and annular seal extend to low permeability unit	NO	2
Highest production 100 feet below static water level	YES	0
Well located outside the 100 year flood plain and protected from surface flooding	YES	0
Total System Construction Score		4

2. Hydrologic Sensitivity

Soils are poorly to moderately drained	YES	0
Vadose zone composed of gravel, fractured rock or unknown	YES	1
Depth to first water > 300 feet	NO	1
Aquitard present with > 50 feet cumulative thickness	NO	2
Total Hydrologic Score		4

3. Potential Contaminant / Land Use - ZONE 1A

		IOC Score	VOC Score	SOC Score	Microbial Score
Land Use Zone 1A	RANGELAND, WOODLAND, BASALT	0	0	0	0
Farm chemical use high	NO	0	0	0	
IOC, VOC, SOC, or Microbial sources in Zone 1A	YES	NO	YES	YES	NO
Total Potential Contaminant Source/Land Use Score - Zone 1A		0	0	0	0

Potential Contaminant / Land Use - ZONE 1B

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant sources present (Number of Sources)	YES	2	2	2	0
(Score = # Sources X 2) 8 Points Maximum		4	4	4	0
Sources of Class II or III leacheable contaminants or	YES	2	2	2	
4 Points Maximum		2	2	2	
Zone 1B contains or intercepts a Group 1 Area	NO	0	0	0	0
Land use Zone 1B	Less Than 25% Agricultural Land	0	0	0	0
Total Potential Contaminant Source / Land Use Score - Zone 1B		6	6	6	0

Potential Contaminant / Land Use - ZONE II

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant Sources Present	NO	0	0	0	
Sources of Class II or III leacheable contaminants or	NO	0	0	0	
Land Use Zone II	Less than 25% Agricultural Land	0	0	0	
Potential Contaminant Source / Land Use Score - Zone II		0	0	0	0

Potential Contaminant / Land Use - ZONE III

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant Source Present	NO	0	0	0	
Sources of Class II or III leacheable contaminants or	NO	0	0	0	
Is there irrigated agricultural lands that occupy > 50% of	NO	0	0	0	
Total Potential Contaminant Source / Land Use Score - Zone III		0	0	0	0

	IOC Score	VOC Score	SOC Score	Microbial Score
Cumulative Potential Contaminant / Land Use Score	6	6	6	0
4. Final Susceptibility Source Score	9	9	9	8
5. Final Well Ranking	Moderate	High	High	Moderate

Ground Water Susceptibility Report — Public Water System Name : THOMPSON CREEK MINING CRUSHER CRU 1 — Well# : CRUSHER - CRU 1

Public Water System Number 7190056 — 1/3/03 2:27:26 PM

1. System Construction

		SCORE
Drill Date	3/1/83	
Driller Log Available	NO	
Sanitary Survey (if yes, indicate date of last survey)	YES	1999
Well meets IDWR construction standards	NO	1
Wellhead and surface seal maintained	NO	1
Casing and annular seal extend to low permeability unit	NO	2
Highest production 100 feet below static water level	YES	0
Well located outside the 100 year flood plain and protected from surface flooding	NO	1
Total System Construction Score		5

2. Hydrologic Sensitivity

Soils are poorly to moderately drained	YES	0
Vadose zone composed of gravel, fractured rock or unknown	YES	1
Depth to first water > 300 feet	NO	1
Aquitard present with > 50 feet cumulative thickness	NO	2
Total Hydrologic Score		4

3. Potential Contaminant / Land Use - ZONE 1A

		IOC Score	VOC Score	SOC Score	Microbial Score
Land Use Zone 1A	RANGELAND, WOODLAND, BASALT	0	0	0	0
Farm chemical use high	NO	0	0	0	
IOC, VOC, SOC, or Microbial sources in Zone 1A	YES	NO	NO	NO	YES
Total Potential Contaminant Source/Land Use Score - Zone 1A		0	0	0	0

Potential Contaminant / Land Use - ZONE 1B

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant sources present (Number of Sources)	YES	2	2	2	1
(Score = # Sources X 2) 8 Points Maximum		4	4	4	2
Sources of Class II or III leacheable contaminants or	YES	2	2	2	
4 Points Maximum		2	2	2	
Zone 1B contains or intercepts a Group 1 Area	NO	0	0	0	0
Land use Zone 1B	Less Than 25% Agricultural Land	0	0	0	0
Total Potential Contaminant Source / Land Use Score - Zone 1B		6	6	6	2

Potential Contaminant / Land Use - ZONE II

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant Sources Present	YES	2	2	2	
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
Land Use Zone II	Less than 25% Agricultural Land	0	0	0	
Potential Contaminant Source / Land Use Score - Zone II		3	3	3	0

Potential Contaminant / Land Use - ZONE III

		IOC Score	VOC Score	SOC Score	Microbial Score
Contaminant Source Present	YES	1	1	1	
Sources of Class II or III leacheable contaminants or	YES	1	1	1	
Is there irrigated agricultural lands that occupy > 50% of	NO	0	0	0	
Total Potential Contaminant Source / Land Use Score - Zone III		2	2	2	0

	IOC Score	VOC Score	SOC Score	Microbial Score
Cumulative Potential Contaminant / Land Use Score	11	11	11	2
4. Final Susceptibility Source Score	11	11	11	10
5. Final Well Ranking	Moderate	Moderate	Moderate	High